Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE
VOL. XCIV, No. 9

FOSSIL CETACEANS FROM THE FLORIDA TERTIARY

BY REMINGTON KELLOGG

WITH SIX PLATES

CAMBRIDGE, MASS., U. S. A.
PRINTED FOR THE MUSEUM
NOVEMBER, 1944

No. 9 — Fossil Cetaceans from the Florida Tertiary[1]

By Remington Kellogg

A number of new and strange types of extinct marine mammals have been brought to light during the past 25 years by the commercial development of the Florida phosphate beds. Several new kinds of fossil cetaceans from these deposits were described by the late Dr. Glover M. Allen, and others, including the small collection here described, were awaiting his attention. Through the kindness of Dr. Thomas Barbour, who made the necessary arrangements for my visit to Cambridge, I was accorded the privilege of studying these specimens.

If the general composition of the Miocene marine faunas of Europe be accepted as a valid basis for correlation, then some of the cetaceans that have been reported to have been dug out of the Bone Valley pebble phosphates are clearly older than the Pliocene and not younger than the upper Miocene. Cooke and Mossom (1929, p. 164) seem to have been the first to suggest that the extinct marine mammals found in these pebble phosphates have been reworked from older formations, particularly the Hawthorn formation, and this conclusion may be applicable in part at least to some of the cetaceans, inasmuch as the long beaked porpoises found in Polk County, Florida, are restricted to the Miocene in European deposits. Although the remains of three long beaked porpoises (*Schizodelphis depressus*, *Schizodelphis bobengi*, and *Pomatodelphis inaequalis*), that have been collected in Polk County, are limited to sections of rostra and mandibles, the structural details of these fragments are so unlike those of Pliocene porpoises there is slight possibility of mistaken identification. No complete skull or associated skeletal parts of cetaceans have ever been reported from the Bone Valley pebble phosphates. The geologic age of the river porpoise (*Goniodelphis hudsoni*) can not be determined with certainty, since this type of odontocete modification occurs in both the upper Miocene and the lower Pliocene. The small sperm whale (*Kogiopsis floridana*) and the balaenopterid hereinafter described seem to be representatives of the Pliocene fauna.

Since most of the recorded species are based on portions of the rostra and of mandibles, it may be assumed that either (1) the fossilized skeletal elements were broken up in the course of commercial dredging and hydraulic mining, or (2) they represent reworked material from an older formation, or (3) they were dislodged from the laminated blue clays underlying the phosphate deposits. A more plausible explan-

[1] Published with the permission of the Secretary of the Smithsonian Institution.

ation for this mixed association of types of cetaceans, that hitherto have been known to occur only in geologic stages of different age, may be found when precise field studies are made of the actual occurrence of these bones in the commercial pits. Officials at the plant of the American Agricultural Chemical Company informed Dr. White (1942, p. 87) that the light brown, dark brown and black specimens came from the pebble phosphate and that the pure white specimens came from the underlying laminated blue clays. Most of the pure white specimens that have been examined represent odontocetes that are considered to belong to the Miocene fauna. One notable exception is found in the material referred to *Goniodelphis hudsoni*, which consists of the grayish white type skull, the light brown ankylosed mandibular rami, and the almost white section of the right mandibular ramus. Some of the specimens belonging to the long beaked porpoises are likewise grayish white. One explanation that may be offered is that some discoloration of reworked specimens subsequently incorporated in more recent deposits may be expected in these shallow formations.

INIIDAE

Goniodelphis hudsoni G. M. Allen

Plate 1; pl. 2, fig. 1

Type. A portion of a cranium, no. 3920, Vertebrate Paleontology Catalogue, Museum of Comparative Zoölogy. Collector, H. L. Hudson.

Referred specimens. (1) A short portion of right mandibular ramus, no. 17879, Vertebrate Paleontology Catalogue, Museum of Comparative Zoölogy. (2) The major portion of the ankylosed mandibular rami, no. 17881, Vertebrate Paleontology Catalogue, Museum of Comparative Zoölogy. Collector, George C. Elmore, 1941.

Horizon and locality. The type and the ankylosed mandibular rami presumably were derived from the pebble phosphate deposits, which belong to the lower Pliocene Bone Valley formation; the short portion of the right mandibular ramus is thought to have been removed from the laminated blue clays, immediately below the pebble phosphate, which are tentatively referred to the middle Miocene Hawthorn formation. All three of these specimens were found in pits of the American Agricultural Chemical Company at Pierce, Polk County, Florida.

Description. Symphyseal portion of mandibular rami (no. 17881, M.C.Z.), measuring 520 mm. in length, broken transversely at seven places; external surface of right ramus (pl. 1, fig. 2) weathered behind

anterior 200-210 mm.; distal 165 mm. of symphysis curves distinctly upward toward anterior broken extremity; symphysis decreases in diameter gradually toward anterior end, both transversely and vertically; angle formed by opposite rami behind symphysis approximately 45 degrees; more than 30 alveoli in each ramus; teeth near anterior end of symphysis implanted in pairs (although opposite alveoli are not separated by equivalent intervals from preceding and succeeding alveoli, the general effect is that of paired teeth); 29th and 30th alveoli (counting forward) in left ramus more or less pandurate in outline; corresponding alveoli in right ramus more nearly elliptical in outline; antero-posterior expansion and side to side compression of roots of mandibular teeth most conspicuous on seven anterior pairs of teeth; roots of anterior mandibular teeth measure about 15 mm. anteroposteriorly (measurements can be taken only near middle of length of root and it is quite possible that distal end of root is somewhat more expanded); behind 24th pair of teeth (counting forward) roots at alveolar level progressively appear less flattened from side to side; teeth less regularly spaced and tend to alternate behind 20th pair of alveoli (counting forward); roots of corresponding teeth more noticeably swollen internally and not so conspicuously expanded anteroposteriorly; alveolar walls broken down for a distance of 60 mm. in front of hinder end of symphysis (boundaries of individual alveoli are so indistinctly defined that it is impossible to describe or measure each individually); opposite alveoli separated by a distance of approximately 5 mm. in portion 100 to 200 mm. behind anterior extremity of symphysis; interval between opposite tooth rows increases imperceptibly toward hinder end of symphysis and measures about 17 or 18 mm. in portion immediately in front of fork of rami; no indication of dorsoventral constriction of rami immediately behind posterior end of symphysis corresponding to condition shown by type mandible of somewhat larger *Saurocetes argentinus* (Burmeister, 1871, pl. 1, fig. 1); five or six minute nutrient foramina located on external face of right ramus below 28th and 29th alveoli (counting forward); several scattered foramina on ventral surface of symphysis; approximately 5 mm. above ventral margin of external face of symphyseal portion of left ramus is a narrow, seemingly discontinuous groove, from which grooves of similar width spaced apart at intervals varying from 10 to 20 mm. extend obliquely forward and upward toward alveolar margin of ramus; anteriormost groove curves upward to about level of center of 28th alveolus (counting forward); second groove ends near anterior end of alveolus of 27th tooth (counting forward); third groove ends

indistinctly near alveolus of 26th tooth (counting forward); fourth groove ends abruptly about 15 mm. below alveolar level of 23rd tooth (counting forward); fifth groove ends abruptly about 15 mm. below alveolar level of 21st tooth (counting forward); remainder of external surface of left ramus weathered to such an extent that original position and direction of grooves can not be determined; on external face of symphyseal portion of right ramus, hindermost visible groove, about 95 mm. in length, extends upward and forward from near ventral margin of ramus to near hinder edge of alveolus of 26th tooth (counting forward); about 15 mm. below above mentioned groove, another similarly directed shorter groove extends toward level of anterior margin of alveolus of 26th tooth (counting forward); anteriormost lateral groove terminates near hinder edge of alveolus of 28th tooth (counting forward).

Section of right mandibular ramus (no. 17879, M.C.Z.), measuring 252 mm. in length; ramus (pl. 2, fig. 1) apparently bends upward

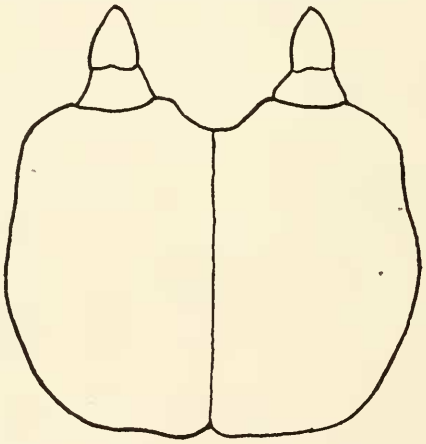


Fig. 1. *Goniodelphis hudsoni*, cross section near hinder end of symphysis, left ramus restored, no. 17879, M.C.Z.

behind level of posterior end of symphysis and seemingly increases in dorso-ventral diameter toward coronoid process; external face of symphyseal portion of right ramus somewhat convex; outer surfaces of opposite rami form more or less V-shaped ridge along ventral line of ankylosis anteriorly; ramus not distinctly constricted behind

symphysis and no indication of pits for reception of apices of teeth in upper jaw like on ramus of *Saurocetes argentinus* (Burmeister, 1871, pl. 1, fig. 1); longitudinal groove on external face narrow, approximately 10 mm. above ventral margin (somewhat similar to groove shown on mandible figured by Burmeister, 1871, pl. 1, fig. 1); two small foramina on lower external face of right ramus, approximately 39 mm. apart, below 2nd and 5th teeth (counting forward); not more than 2 teeth in right ramus wholly behind level of posterior end of symphysis; teeth (fig 1) with simple conoidal crown, slightly curved backward and inward toward apex; crown not noticeably laterally compressed; yellowish brown enamel on crown unevenly wrinkled by fine striae; neck of root below crown short, not markedly constricted; root swollen below neck, more noticeably internally than externally, and expanded antero-posteriorly; distal end of root conspicuously expanded antero-posteriorly and markedly flattened from side to side.

Measurements (in millimeters):

Length of ankylosed mandibular rami (no. 17881, M.C.Z.), as preserved		520
Right mandibular ramus, 27 anterior alveoli (4th to 30th alveolus counting forward from hindermost) in an interval of		473
Right mandibular ramus, 6 anterior alveoli (24th to 29th alveolus counting forward) in an interval of		119
Right mandibular ramus, 5 posterior alveoli (4th to 8th alveolus counting forward) in an interval of		65
Dorso-ventral diameter of right ramus about 30 mm. in front of posterior end of symphysis		39 +
Left mandibular ramus, 27th tooth (counting forward):	Right	Left
antero-posterior diameter of tooth near middle of length of root	16.8	15.0
transverse diameter of tooth near middle of length of root	7.8	8.5
Left mandibular ramus, 25th tooth (counting forward):		
antero-posterior diameter of tooth near middle of length of root	15.1	17.4
transverse diameter of tooth near middle of length of root	5.5	7.2
Dorso-ventral diameter of right ramus between 23rd and 24th alveoli (counting forward)		33.2
Greatest transverse diameter of same		24.7

Length of a portion of right ramus (no. 17879, M.C.Z.)	252
11 teeth in an interval of	145
5 posterior alveoli (4th to 8th alveolus counting forward from hindermost) in an interval of	65

Dorso-ventral diameter of right ramus at posterior end of symphysis	42.5
Dorso-ventral diameter of right ramus at level of 11th tooth (counting forward)	40
Right ramus, 6th tooth (counting forward):	
antero-posterior diameter of crown at base	6.5
transverse diameter of crown at base	6.3
height of crown, inside	7.2
antero-posterior diameter of root at alveolar level	11.0
transverse diameter of root at alveolar level	9.5
Right ramus, isolated tooth (probably 8th counting forward):	
greatest length of tooth	26.3
antero-posterior diameter of root near extremity	15.2
antero-posterior diameter of expanded portion of root below crown	12.0
transverse diameter of expanded portion of root below crown	9.4
antero-posterior diameter of crown at base	6.5
transverse diameter of crown at base	6.2
height of crown, outside	7.8
Type skull (no. 3920, M.C.Z.), apex of supraoccipital to point of divergence of opposite premaxillaries (corresponding in cross section to level of posterior margin of hindermost alveolus in right maxillary)	250
Apex of supraoccipital to level of assumed antorbital notch on right maxillary (Allen, 1941, pl. 1)	230
16 alveoli in left maxillary in an interval of	167
8 alveoli (1st to 8th counting forward) in right maxillary in an interval of	93
Distance between inner margins of hindermost alveoli in right and left maxillaries	71.8
Distance between inner margins of 6th teeth (counting forward) in right and left maxillaries	25
Distance between inner margins of 9th teeth (counting forward) in right and left maxillaries	11
Right maxillary, 7th tooth (counting forward):	
antero-posterior diameter of crown at base	7.8
transverse diameter of crown at base	6.7
antero-posterior diameter of root at alveolar level	10.0
transverse diameter of root at alveolar level	9.5
Length of right palatal groove (anterior wall of narial passage to anterior end of groove)	98
Palatal surface, anterior wall of left narial passage to anterior end of palatal exposure of vomer	241

Remarks. Some of the extinct porpoises, which have been compared with *Goniodelphis hudsoni* by Allen (1941, pp. 7-8) are considered by the writer to have somewhat different relationships.

The extinct porpoise *Saurocetes argentinus* (Burmeister, 1871, p. 51) was based on two fragments of mandibles from an unknown locality, although the matrix indicated that these specimens had been found in the early Pliocene deposits on the shores of the Paraná River. The larger fragment (Burmeister, 1871, pl. 1, fig. 1) comprising the hinder portion of the symphysis, both rami having been broken off a short distance behind the latter, is 15 inches (381 mm.) long and 2½ inches (63.5 mm.) dorso-ventrally in front of hinder end of symphysis, but only 1¾ inches (44.45 mm.) at the distal end. The symphyseal portion is 11 inches (279.4 mm.) long, 1½ inches (38 mm.) wide at distal end, and 2⅙ inches (55 mm.) wide at posterior end. Burmeister estimated the length of the entire mandible to be 30 to 32 inches. The smaller fragment (Burmeister, 1871, pl. 1, fig. 4) represents a short piece of the right ramus from the region immediately behind the symphysis. On the outer face of the left ramus and somewhat above the ventral margin is a channel or furrow, beginning at about the posterior end of the symphysis and extending forward, from which numerous wrinkles rather evenly spaced extend obliquely forward and upward to below the alveolar margin. In cross section (Burmeister, 1871, pl. 1, fig. 2) the symphysis is triangular, with rounded contours. The median region between the alveoli is somewhat elevated above the sides. There are 12 alveoli (6 teeth) in the left ramus and 7 alveoli (3 teeth) in the right ramus. The teeth are not closely approximated anteriorly, and behind and external to each is a small circular cavity, apparently for lodging the apex of the corresponding upper tooth when the jaws were shut. The hindermost tooth in the left ramus alone is situated behind the posterior end of the symphysis. The teeth are large, having conical crowns which are slightly compressed from side to side, somewhat curved backward, and covered irregularly with wrinkled enamel. Between the base of the crown and the gibbous portion of the root is a well marked neck or constriction. The extremity of the root is compressed from side to side and irregularly divided into two or three rootlets. The detached tooth figured by Burmeister (1871, p. 54, pl. 1, fig. 3) is 2 inches (50.8 mm.) long, of which the height of the crown is 8 lines (18.86 mm.), the neck 1½ lines (3.18 mm.), and the length of the root 15 lines (31.8 mm.).

Inasmuch as *Saurocetes* Burmeister was considered to be preoccupied by *Saurocetus* Agassiz, and since he had ascertained that the teeth of

the Argentine odontocete were quite different from those of the animal previously described by Agassiz, Burmeister (1891a; 1891b, p. 162) withdrew the name *Saurocetes argentinus* and replaced it with *Saurodelphis argentinus*. In August of the same year, Ameghino (1891b, p. 255) proposed *Pontoplanodes* as a substitute for the generic name *Saurocetes* Burmeister, and specifically designated *Saurocetes argentinus* as the genotype. Consequently, as pointed out by Cabrera (1926, p. 397), *Saurocetes argentinus* Burmeister (January, 1871,)*Saurodelphis argentinus* Burmeister (June, 1891), and *Pontoplanodes argentinus* Ameghino (August, 1891) are absolute synonyms. Both Rovereto (1915, p. 143) and Cabrera prefer to employ *Saurodelphis* in place of *Saurocetes*, notwithstanding the provisions of the International Rules of Zoological Nomenclature (see art. 36, recommendations; "names which differ from generic names already in use only in termination or in a slight variation in spelling . . . are not to be rejected on this account," as for example *Polyodonta*, *Polyodontas*, *Polyodontus*.).

In 1892, Burmeister described and figured an imperfect skull from the cliffs at La Curtiembre on the shore of the Paraná River. In restoring the skull, Burmeister (1892, pl. 8, figs. 1 and 5) used the skull of the Recent *Stenodelphis* as a model, but neglected to show the three teeth preserved in the right maxillary and added the terminal portion of the rostrum (1892, pl. 8, fig. 2) of another odontocete. Burmeister (1892, p. 456, pl. 8, fig. 6) reconstructed the type mandible of *Saurocetes argentinus* by adding the anterior end of the symphysis of another individual, in which the teeth are smaller and have a very large, laterally compressed and antero-posteriorly expanded root of irregular form, and a high laterally compressed crown. The terminal portion of the symphysis diminishes in height rapidly near the tip. This reconstructed skull and mandible were referred by Burmeister to *Saurodelphis argentinus*, and much of the confusion regarding the structural peculiarities of this extinct porpoise may be traced to this restoration.

Abel (1909, pp. 257, 271), having obtained photographs of the above-mentioned skull and the terminal portion of the rostrum, concurred with the opinion written by F. Ameghino that they belonged to two different porpoises, and stated that the cranium undoubtedly represented a member of the Iniidae. Abel, however, adopted an ill-advised procedure to make names available for these two porpoises. The name *Saurodelphis argentinus* was restricted by Abel to this skull. Abel (1909, pp. 258–259), furthermore, concluded that the mandible described by Burmeister in 1871, the terminal portion of the rostrum figured by Burmeister in 1892, as well as the mandibular fragment

described by Ameghino (1891a, p. 163, fig. 71) under the name of *Saurocetes obliquus* should be designated as *Pontoplanodes argentinus.*

The critical analysis published by Cabrera (1926, pp. 396–403) shows rather conclusively that the type mandible (Burmeister, 1871, pl. 1, fig. 1; Rovereto, 1915, pl. 2, figs. 1–2) and the terminal portion of the rostrum (Burmeister, 1892, pl. 8, fig. 2; Abel, 1909, pl. 1, fig. 3) are referable to *Saurocetes argentinus.* Cabrera (1926, p. 401) has also shown that *Saurocctes obliquus* (Ameghino, 1891a, p. 163, fig. 71) does not represent the anterior part of the mandibular symphysis as stated by Ameghino, but agrees absolutely with the terminal portion of the rostrum of *Saurocetes argentinus.*

According to Cabrera (1926, pp. 402–403), the skull of *Saurocetes argentinus* is distinguished from that of *Inia geoffrensis* by the following details: the elevated vertex (formed by union of nasals, frontals and supraoccipital) is higher and more inclined backward; the anterior border of the nasal passages, which is constituted by close approximation of the premaxillaries, forms an open inverted "V"; the lateral occipital crests are more closely approximated, the minimum distance between the crests being 55 mm.; the supraoccipital is deeply concave dorsally; and the upturned lateral borders of the ascending plates of the maxillaries and the underlying lateral supratemporal extensions of the frontals form a narrower and deeper depression than in *Inia.* The mandible is constricted dorso-ventrally behind the level of the posterior end of the symphysis. The teeth (Rovereto, 1915, p. 146) are relatively large, the antero-posterior diameter at base of the crowns of the mandibular teeth varying from 19 to 22 mm.; only one tooth is situated behind the posterior end of the symphysis; the five posterior alveoli (1st to 5th counting forward) in the left ramus occupy an interval of 94 mm., and the 7 anterior ones (6th to 12th) 188 mm.; the hindermost as well as the penultimate mandibular alveoli are rounded, but thence forward the alveoli tend to assume an elliptical form; the alveoli on the terminal portion of the rostrum and mandible are constricted medially, the outline being pandurate; the antero-posterior diameter of the root of the 5th tooth (type rostral fragment of *Saurocetes obliquus* Ameghino, 1891, p. 163) at level of alveolar margin is 20 mm. and the antero-posterior diameter of the same tooth at base of the crown is 16 mm.; the five maxillary teeth occupy an interval of 90 mm. Notwithstanding the lack of harmony in the measurements of the alveoli when computed in accordance with the scale of reduction indicated for published illustrations (Burmeister, 1892, pl. 8, fig. 2; Ameghino, 1898, p. 221, figs, 86a–d) of the terminal rostral fragment,

it would appear that the antero-posterior diameter of these alveoli is not less than 20 mm. and probably not more than 28 mm., since the largest alveolus on the rostral fragment described by Cabrera (1926, p. 400) measures 23 mm. antero-posteriorly and 9 mm. transversely.

It remained for Cabrera (1926, p. 403) to discover that the incomplete skull, which had been identified as *Saurodelphis argentinus* by Burmeister (1892, pl. 8, figs. 1 and 5; Abel, 1909, pl. 1, figs. 1–2), as well as another skull belonging to the Museo de La Plata should be referred to *Ischyrorhynchus vanbenedeni* and to suggest that it was not impossible that the type mandible of *Anisodelphis brevirostratus* (Rovereto, 1915, p. 149, pl. 4, figs. 1–2) belonged to the same porpoise. Cabrera seems to have been the first to notice that the type of *Ischyrorhynchus vanbenedeni* (Ameghino, 1891a, p. 163, fig. 72) did not represent a portion of the mandibular symphysis as stated by Ameghino, but that it was actually a rostral fragment. That this allocation is probably correct is shown not only by the form of the teeth *in situ*, but also by the similarity in the dimensions of corresponding parts, the transverse diameter of the type rostral fragment of *Ischyrorhynchus vanbenedeni* being 31 mm. and that of the middle portion of the rostrum of Burmeister's skull 30 mm.

The imperfect skull of *Ischyrorhynchus vanbenedeni* (Burmeister, 1892, pl. 8, figs, 1, 5; Abel, 1909, pl. 1, figs. 1, 2), which lacks the terminal portion of the rostrum as well as the occipital region, has a length of about 637 mm. and was at least 303 mm. in breadth across the bases of the zygomatic processes when complete. Abel (1909, pp. 269–271)points out that the skull of *Ischyrorhynchus* is characterized as follows: the posterior ends of the ascending plates of the maxillaries project farther backward than in *Inia*; the vertex (constituted by the frontals) is pushed farther back than in *Inia*; the distance between the upturned borders of the ascending plates of the maxillaries is much less than in *Inia*; the posterior wall of the nasal passages is much less inclined forward than in *Inia* and consequently more of the flat nasal bones can be seen, when viewed from above. With reference to the anterior border of the squamosal, when seen from above, the nasal passages as well as the vertex and the posterior ends of the maxillaries are pushed considerably farther backward than in *Inia*, but the last two distinctions mentioned by Abel are based on somewhat dubious assumptions. In addition, the skull of *Ischyrorhynchus* can be distinguished readily from that of *Inia* by its size, by the length of the palatal grooves, by the relations of the palatine bones, and especially by the shape and dimensions of the teeth. Although the entire basi-

cranial region is destroyed, the relations of the bones in the preserved portion of the type skull indicate that *Goniodelphis* was somewhat similar to *Ischyrorhynchus* in these above-mentioned details. Cabrera (1926, p. 403) concludes that the skull of *Ischyrorhynchus vanbenedeni* is distinguished from that of *Saurocetes argentinus* by the greater elevation and large size of the knob-like vertex, and by the open inverted "U" contour of the anterior border of the nasal passages.

Rovereto (1915, p. 151) has published the following measurements for the maxillary teeth (probably the 14th or 15th counting forward) of *Ischyrorhynchus vanbenedeni*: antero-posterior diameter of crown at base, 17 mm.; transverse diameter of crown at base, 10 mm.; height of crown, 5 mm.; interval between opposite tooth rows, 6 mm. As regards the teeth located near the middle of the rostrum, Ameghino (1891, p. 165) states that the average diameter of their roots at the level of the alveolus is 13 mm.; the crown of a detached tooth is said to measure 9 mm. antero-posteriorly and transversely at the base. Should the allocation of *Anisodelphis brevirostratus* (Rovereto, 1915, p. 150) to *Ischyrorhynchus vanbenedeni* be confirmed, the mandible is characterized as follows: the anterior alveoli are separated by interspaces of 18 to 24 mm.; the 7 hindermost alveoli are separated by interspaces of 5 mm.; at the posterior ends of the tooth rows the teeth are opposite one another and anteriorly they are not opposite but alternated; one tooth is situated behind the posterior end of the symphysis.

Presumably the identical specific names lead Allen (1941, p. 7) to confuse the skull of the extinct ziphioid whale *Diochotichus vanbenedeni* (True, 1910) with that of *Ischyrorhynchus vanbenedeni*.

Doubtless a certain relationship exists between *Goniodelphis* and *Proinia* (True, 1909), but not a close one. In the last mentioned genus, the posterior wall of the nasal passages is not at all inclined backward and the ascending plates of the maxillaries, though narrow, are directed forward and downward, rather than outward and upward. While both genera have been assigned to the Iniidae, they do not exhibit any close similarities.

Our knowledge of *Hesperocetus californicus* (True, 1912) is limited to two pieces of the ankylosed rami, comprising the anterior portion of the symphysis, which were found in the upper Miocene upper San Pablo formation near Rodeo, California. Contrary to Allen's assertion, *Hesperocetus* could hardly have been larger than *Goniodelphis*, since the dimensions of the corresponding portions of the symphysis are approximately the same. Nevertheless, *Hesperocetus* does not seem to be

related closely either to *Goniodelphis* or to any of the described Tertiary Iniidae. The tips of the teeth in the upper series are fitted into elongated depressions in the interspaces between the alveoli in the corresponding lower series. This peculiar alternation in the symphyseal region of transverse pairs of teeth and of transverse pairs of elongated depressions in the interspaces is not duplicated in any of the known extinct iniids. The teeth are relatively large, the crowns at their bases measuring from 8 to 10 mm. antero-posteriorly and from 8 to 8.5 transversely. The alveoli in the longest symphyseal fragment measure 9 mm. transversely and from 14 to 20 mm. antero-posteriorly; the interspaces average about 20 mm. antero-posteriorly. There are three alveoli in the left ramus in an interval of 91 mm. The presence of relatively large foramina, which open into grooves not more than 10 mm. in length and which are spaced at intervals of 40 to 60 mm. on the lateral symphyseal surface of the ramus, characterize the mandibles of *Hesperocetus* and *Inia*. No trace of a longitudinal lateral furrow, such as is present on the symphyseal portions of the mandibles of *Goniodelphis* and *Saurocetes*, can be detected on the mandibular symphysis of *Hesperocetus*.

Goniodelphis is a small-toothed iniid, whose skull and mandibles may be distinguished readily from those of previously described river porpoises by the following combination of characters:

The vertex is narrow, transversely widened (32 mm.), and much less elevated than on the crania of either *Inia, Saurocetes* or *Ischyrorhynchus;* the posterior wall of the nasal passages is not so steep as in *Inia* but is inclined backward at an angle of about 30° with the palate; a shallow depression, about 25 mm. long and deeper ventrally, located at the top of the posterior wall of the nasal passages, marks the position of the flattened squarish nasal bones; the longitudinal depression formed by upturned lateral borders of ascending plates of maxillaries and underlying lateral supratemporal extensions of frontals is not so deep as in Inia; the anterior border of the narial passages is constituted by close approximation of the premaxillaries, forming a wide open inverted "U" like in *Ischyrorhynchus;* the rostrum is noticeably expanded near the base and narrowed toward the extremity; posterior maxillary and mandibular alveoli are rounded; anterior maxillary and mandibular alveoli are elongated, the anteriormost mandibular alveoli being somewhat pandurate in outline and thus resembling *Saurocetes;* the teeth are much smaller than those of either *Saurocetes* or *Ischyrorhynchus,* the antero-posterior diameter of anterior mandibular alveoli varying from 15 to 18 mm., and the antero-posterior diameter at base

of the crowns of mandibular teeth from 5.5 to 7.8 mm.; not more than two teeth are situated behind the posterior end of the symphysis; the 5 anterior teeth (12th to 16th counting forward) on the type skull occupy an interval of 61 mm., which corresponds very closely with the 60 mm. interval for the same teeth on an *Inia* skull (no. 239667, U S.N.M.).

DELPHINIDAE

Megalodelphis, new genus

Genotype. Megalodelphis magnidens new species.

Diagnosis. Rostrum and symphyseal portion of mandibular rami elongated and compressed dorso-ventrally; 7 teeth in ramus behind level of posterior end of symphysis; crowns of mandibular teeth more or less flattened from side to side and curved inward toward apex; enamel on crowns lightly striated, with a distinct vertical carina on anterior and posterior cutting edges.

This odontocete is further characterized by the unusually large dimensions of the upper and lower jaws, in fact it is the largest known long-beaked porpoise, either extinct or living.

Megalodelphis magnidens, new species

Plate 2, fig. 2; pl. 3.

Type. A posterior symphyseal section of the ankylosed mandibular rami, no. 17883, Vertebrate Paleontology Catalogue, Museum of Comparative Zoölogy. Collector, George C. Elmore, 1941.

Referred specimen. A short portion of the rostrum, no. 17880, Vertebrate Paleontology Catalogue, Museum of Comparative Zoölogy, Collector, George C. Elmore, 1941.

Horizon and locality. Laminated blue clays, immediately below the pebble phosphate, which are tentatively referred to the Hawthorn formation, in pits of the American Agricultural Chemical Company at Pierce, Polk County, Florida. Middle Miocene (Simpson, 1932, p. 425; White, 1942, p. 87).

Description. Short section of left mandibular ramus (pl. 3, fig. 2), including hinder portion of symphysis, crushed; hinder portion of left ramus split lengthwise, thus separating opposite walls of alveoli; symphyseal region dorso-ventrally flattened, judging from conformation of hinder end; seven alveoli in left mandibular ramus behind level

of symphysis, with teeth *in situ* in three alveoli; alveoli relatively large in comparison to size of roots of teeth; two cavities (fifth and sixth counting forward from hindermost alveolus) interpreted as representing alveoli occupied by corresponding teeth in milk dentition; fourth permanent tooth (counting forward) in left ramus erupting normally and protruding far enough for apex of crown to become worn; fifth permanent tooth (counting forward) erupting in interspace between fifth and sixth alveoli for milk teeth, with apex of crown worn; no remnant of sixth permanent tooth, except for dubious cavity in spongiosa anterior to root of fifth permanent tooth; seventh permanent tooth (counting forward) not fully erupted and apex of crown complete; eighth permanent tooth (counting forward) fully erupted, with apex of crown worn off; depression (length, 10 mm.; width, 7 mm.) antero-external to eighth alveolus and in interspace between eighth and ninth alveoli for apex of corresponding tooth in upper jaw; ninth and tenth alveoli represented by external rims; crowns of teeth, (pl. 2, fig. 2) flattened from side to side, curved inward toward apex; generally blackish enamel on crown with concentric bands of lighter color and lightly ornamented with more or less vertical anastomosing striae; distinct vertical carina on anterior and posterior cutting edges.

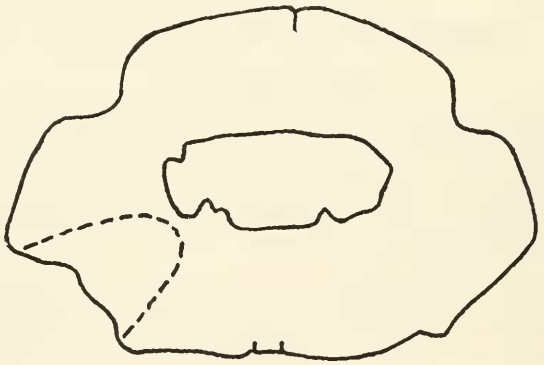


Fig. 2. *Megalodelphis magnidens*, cross section of rostral fragment, 70 mm. in front of posterior end, no. 17880, M.C.Z.

Section of rostrum (no. 17880, M.C.Z.) 336 mm. in length; whole or portions of seven alveoli present in left maxillary, six being sufficiently complete for measurement; eight alveoli in right maxillary less satisfactorily preserved, the four anterior to hindermost alveolus being

nearly complete; interval between opposite rows of alveoli varying from 35 to 40 mm.; roots of maxillary teeth attenuated and bent upward and backward, judging from direction and shape of alveoli; ankylosis of parallel premaxillaries complete, line of union marked by irregular furrow or groove; width of ankylosed premaxillaries anteriorly, 43.5 mm.; lateral rostral groove broad (10+ mm. in width), presumably marking line of ankylosis of premaxillaries and maxillaries; mesorostral gutter (fig. 2) completely enclosed by premaxillaries and maxillaries, and wider than high; opposite maxillaries ankylosed along mid-line; apices of teeth in mandible seemingly in contact with upper jaw in interspaces between maxillary alveoli, the depressions (pl. 3, fig. 1) being located external to external margin of maxillary alveoli.

Measurements (in millimeters):

Length, as preserved, of left mandibular ramus (no. 17883, M.C.Z.)	330
Transverse diameter of rami at level of fork at hinder end of symphysis, estimated	145 ±
9 hindermost alveoli in an interval of	213
Anterior margin of alveolus of third tooth to anterior margin of root of eighth tooth (counting forward from hindermost alveolus)	117.6
Left mandibular ramus:	
Fourth tooth, counting forward from hindermost alveolus:	
antero-posterior diameter of crown at base	13.0
transverse diameter of crown at base	9.7
height of crown inside (apex worn)	14.0
antero-posterior diameter of root below crown	17.8
Tooth in interspace between fifth and sixth alveoli for milk teeth:	
antero-posterior diameter of crown at base	13.0
transverse diameter of crown at base	10.0
height of crown inside (apex worn)	14.4
antero-posterior diameter of root below crown	14.5
Seventh tooth, counting forward from hindermost alveolus:	
antero-posterior diameter of crown at base	14.7
transverse diameter of crown at base	9.7
height of crown inside (apex complete)	15.0
Eighth tooth, counting forward from hindermost alveolus:	
antero-posterior diameter of crown at base	15.0
transverse diameter of crown at base	12.7
height of crown inside (apex worn)	21.3
antero-posterior diameter of root below crown	18.5
Length of rostral fragment (no. 17880, M.C.Z.)	336
Transverse diameter 70 mm. anterior to hinder end of rostral fragment	70.5

Vertical diameter 70 mm. anterior to hinder end of rostral fragment	47.5
4 alveoli in right maxillary in an interval of	136
6 alveoli in left maxillary in an interval of	244
Right maxillary, counting forward from hindermost alveolus:	
Second alveolus, antero-posterior diameter	25
Second alveolus, transverse diameter	18
Interspace between second and third alveoli	12
Third alveolus, antero-posterior diameter	25.4
Third alveolus, transverse diameter	17.3
Interspace between third and fourth alveoli	12.3
Fourth alveolus, antero-posterior diameter	23.0
Fourth alveolus, transverse diameter	17.7
Interspace between fourth and fifth alveoli	12.3
Fifth alveolus, antero-posterior diameter	25.5
Fifth alveolus, transverse diameter	19.4

Remarks. There are only two extinct odontocetes that approach the Florida porpoise in size. In view of the confusion that still seems to persist regarding the valid name for one of these porpoises, it is necessary to review briefly the history of the "dauphin à longue symphyse de la mâchoire inférieure" of Cuvier (1825, ed. 3, vol. 5, p. 312, pl. 23, figs. 4–5, 9–11), to which two names, *Champsodelphis macrogenius* (Fischer) and *Champsodelphis bordae* (Holl), were applied in 1829. Both of the above mentioned names were based on the incomplete mandible and the rostral fragment, which Cuvier had described and figured. These two specimens came from the Helvetian shell marl at Sort; 8 kilometers from Dax, Departement Landes, France, and must be considered as co-types. Cuvier saw in the museum at Dax the incomplete mandible, measuring 16 French inches [=433 mm.] in length, on which there are 12 alveoli (4 teeth) in the right ramus and 18 alveoli (10 teeth) in the left ramus. The short rostral fragment, measuring 178± mm. in length, on which there are 4 alveoli (2 teeth) in the right maxillary and 3 alveoli (1 tooth) in the left maxillary was presented in 1803 by Borda to the Museum National d'Histoire Naturelle, Paris.

Valenciennes (1862, pp. 789–790) seems to have been the first to observe that the extinct porpoise to which the rostral fragment (Cuvier, 1825, pl. 23, figs. 9–11) belonged was quite distinct from the one represented by the mandibles (Cuvier, 1825, pl. 23, figs. 4–5). In support of his contention that the name *Champsodelphis macrogenius* had been founded on specimens representing specifically distinct porpoises, Valenciennes in describing the rostral fragment directs attention to the teeth, which are characterized by their dimenisons, by the

absence of any trace of a small heel or blunt tubercle at the base of the crown posteriorly (notwithstanding the statement of Cuvier), and by the different appearance of the enamel on the crown. Valenciennes, however, did not restrict the name *Champsodelphis macrogenius* to either of the above mentioned specimens.

Brandt (1873, p. 264) decided to ignore *Champsodelphis macrogenius*, inasmuch as this name was based on parts of two distinct porpoises. For the rostral fragment (Cuvier, 1825, p. 313, pl. 23, figs. 9–11), Brandt (1873, p. 266) proposed the new name *Champsodelphis valenciennesii*. Consequently, Brandt actually restricted the name *Champsodelphis macrogenius* to the mandible (Cuvier, 1825, p. 312, pl. 23, figs. 4–5), notwithstanding the fact that he (Brandt, 1873, p. 263) proposed the new name *Champsodelphis macrognathus* for this specimen. Whether or not *Champsodelphis macrogenius* (Fischer) has priority over *Champsodelphis bordae*(Holl) has not been determined, since both were published in 1829, but both of these names are many years older than *Champsodelphis macrognathus* (Brandt). Since this method of elimination is not specifically covered by the International Rules of Zoological Nomenclature, in order to obviate any possible confusion the mandible is herewith designated as the lectotype of both *C. macrogenius* and *C. bordae*.

The alveoli on the rostral fragment alloeated to *Megalodelphis magnidens* are much larger than those on the type rostral fragment of *Champsodelphis valenciennesii*, the measurements of the alveoli of the former varying from 23 to 25.5 mm. antero-posteriorly, and from 17.3 to 19.4 mm. transversely, whereas an alveolus of the latter measures 18.4 mm. antero-posteriorly and 14 mm. transversely. Furthermore, the rostral fragment of *C. valenciennesii* has somewhat different proportions, being higher than wide (dorso-ventral diameter, 55 mm.; transverse diameter, 53 mm.), whereas the rostral fragment referred to *M. magnidens* is noticeably wider than high (dorso-ventral diameter-47.5 mm.; transverse diameter, 70.5 mm.).

It seems almost certain that the mandible found at Sort represents a porpoise quite different from *Megalodelphis magnidens*, since the teeth have a small heel or blunt tubercle at the base of the crown posteriorly and a somewhat smaller crown. The dimensions of one tooth are stated by Cuvier to be as follows: height, 15 mm., and diameter at base approximately, 11 mm.; the interspace between alveoli is stated to be 20 mm. A more important difference is indicated by the presence of ten or more teeth on the ramus posterior to the level of the hinder end of the symphysis of *Champsodelphis macrogenius*, whereas only

seven teeth are present on the corresponding portion of the mandible of *Megalodelphis magnidens*. Moreover, the symphyseal portion of the mandibles of *C. macrogenius* is much narrower, the transverse diameter at the hinder end of the symphysis (50 mm.) being about one-third of that of *M. magnidens* (145± mm.), and is less markedly compressed in a dorso-ventral direction.

Distinction between *Megalodelphis magnidens* and the Miocene *Macrodelphinus kelloggi* (Wilson, 1935, pp. 28–58, figs. 4–9), several specimens of which have been collected in the Pyramid Hills sand, about 5 miles southwest of Woody, Kern County, California, is not restricted to minor details. It is obvious at first glance that the dorso-ventrally compressed mandibular symphysis and rostrum of *M. magnidens* is wholly unlike that of this Miocene porpoise from California. One may infer that the elongated mandibular symphysis and rostrum of *M. magnidens* suggested a long-beaked skull similar in general shape to the corresponding portions of *Pomatodelphis*, *Schizodelphis*, and *Zarhachis*. Moreover, behind the level of the symphysis there are 14 alveoli in an interval of 203 mm. on the right ramus of *M. kelloggi* in contrast to the 7 alveoli in an interval of 162.5 mm. on the corresponding portion of the mandible of *M. magnidens*. From the dimensions, it will be seen that *M. magnidens* surpassed in size the largest of all previously described fossil porpoises.

If we examine in detail the type skull and other specimens allocated to *Macrodelphinus kelloggi*, we find a number of well marked peculiarities that suggest rather strongly some sort of a relationship with at least one of the less completely known porpoises from the Helvetian shell marl near Dax, France. The dimensions and conformation of the cross section of the rostrum of *M. kelloggi* (Wilson, 1935, fig. 4a) are surprisingly close to the corresponding rostral section of *C. valenciennesii* (see *Champsodelphis macrogenius* Gervais, 1859, pl. 41, fig. 6b). It is possible that the skull of *Champsodelphis valenciennesii* may have had a rostrum somewhat similar to that of *M. kelloggi*. Although similar in general conformation, the teeth of the French form may average slightly larger than those of the Californian porpoise, as is indicated by the following measurements:

	Champsodelphis valenciennesii	Macrodelphinus kelloggi
In left maxillary, there are 3 alveoli in an interval of	69.5	51.0
A right maxillary tooth:		
Antero-posterior diameter of crown at base	12.2	8.0
Transverse diameter of crown at base	9.5	9.0
Vertical height of enamel crown	15.0	13.4

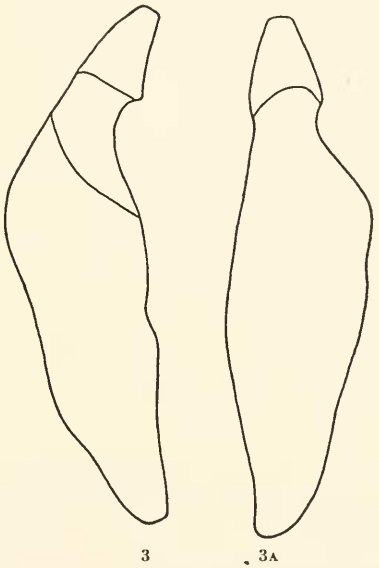
Some allowance, however, must be made for individual size variation

A careful examination of the rostral fragment, which constitutes the type of *Champsodelphis valenciennesii*, failed to convince the writer that Abel (1899, p. 841) was correct in suggesting that this species might belong in the genus *Tursiops*. It is quite obvious that *valenciennesii* does not belong in the genus *Champsodelphis*. Since the type rostral fragment seems not to differ appreciably either as regards size or conformation from the corresponding section of the rostrum of *Macrodelphinus kelloggi*, *valenciennesii* may be assigned tentatively to the genus *Macrodelphinus*.

PHYSETERIDAE

? Hoplocetus, species indet.

Referred specimens. Two teeth, no. 17886, Vertebrate Paleontology Catalogue, Museum of Comparative Zoölogy. Collector, George C. Elmore, 1941.



3 3A

Fig. 3. ? *Hoplocetus*, species indet., lateral view of tooth. Fig. 3a.—anterior view of tooth, no. 17886, M.C.Z.

Horizon and locality. Presumably from the pebble phosphate deposits, which are referred to the Bone Valley Formation, in pits of the American Agricultural Chemical Company at Pierce, Polk County, Florida. Lower Pliocene (Simpson, 1930, pp. 177–185; 1932, pp. 445–446, 469).

Description. The crowns of these two teeth are conical, 24 to 26 mm. in height, and slightly curved backward. The shortest tooth (fig. 3, 3a) has the enamel on the crown ornamented with coarse anastomosing striae. Below the base of the enameled crown the neck of the root is deeply worn on one side. The root is gibbous near the middle and tapers to the extremity. The pulp cavity seems to be completely closed.

The other tooth (fig. 4) is considerably longer and exhibits a more regular conformation. The enamel on the crown is less noticeably

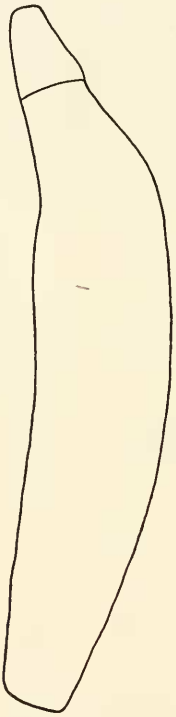


Fig. 4. ? *Hoplocetus*, species indet., lateral view of tooth, no. 17886, M.C.Z.

wrinkled, although anastomosing striae directed more or less dorsoventrally are present. The long axis of the root is weakly curved from end to end. The neck of the root is slightly constricted below the base of the crown. At the extremity of the root is an orifice for the 112 mm. long pulp cavity which extends toward the crown; the transverse diameter of the pulp cavity is 10 mm.

Measurements (in millimeters):

Greatest length of tooth	190.5	138.2
Antero-posterior diameter of crown at base	20.2	20.2
Transverse diameter of crown at base	21.5	20
Height of crown inside, apex worn	24	26
Greatest antero-posterior diameter of root	41.5	45.2
Greatest transverse diameter of root	36.6	39

Remarks. Teeth of this same general appearance have been referred to several genera. Some of these genera seem to have served as "catch-alls" for species that, although based solely on teeth and other inadequate skeletal remains, are derived from formations ranging in age from lower Miocene (Langhian) to lower Pliocene (Plaisancian). Nevertheless, Abel (1905, p. 52) placed eight of these genera in the synonymy of *Scaldicetus*. It is difficult to justify this procedure, especially in view of the similar appearance of the teeth of a number of valid generic types of Miocene physeteroid whales, for which readily recognizable skulls are available, as for instance *Aulophyseter*, *Diaphorocetus*, *Idiophyseter*, *Idiorophus*, *Orycterocetus*, *Physeterula*, *Scaldicetus*, and *Thalassocetus*. The mandibular teeth of the Recent sperm whale *Physeter catodon* are not uniform in either size or conformation, and there is no valid basis for an assumption that less individual variation will be exhibited by the teeth of one of these extinct physeteroids. The 45 teeth constituting the type of *Scaldicetus caretti* vary in length from 200 to 240 mm. Regardless of variance of opinions as to the precise generic allocation of species based wholly on teeth, it seems desirable, nevertheless, in the absence of satisfactory information in regard to the skull to refer these two teeth from Florida to a described genus. Inasmuch as these teeth exhibit a general conformation somewhat similar to those of *Hoplocetus crassidens*, they are referred tentatively to *Hoplocetus*. The genotype, *Hoplocetus crassidens* (Beneden and Gervais, 1880, p. 340, pl. 20, figs. 26–27), was based on two teeth from the middle Miocene (Helvetian) shell marl at Romans, Departement Drôme, France. The enamel on the crown of the smallest tooth is more distinctly wrinkled than that on the other tooth, and the apices of the crowns of both teeth are worn. The crown of the largest tooth, as preserved, measures 11 mm. in height and that of the other tooth 17 mm. These two teeth, one of which has a distinctly swollen root, have the top of the root distinctly constricted below the base of the crown, forming a short neck. The lengths of the roots of these two teeth are respectively 110 and 94 mm.

Portions of skulls of three odontocetes were allocated to *Diaphorocetus mediatlanticus* by Allen (1921, p. 154). One of these, comprising a section of the rostrum which measures 288 mm. in length as well as the corresponding portion of the ankylosed mandibular rami (Allen, 1921, p. 155, pl. 12, fig. 13; no. 10922, Div. Vert. Paleont., U. S. Nat. Mus.), seems to be allied to if not identical with *Megalodelphis magnidens*. The second, a section of the ankylosed mandibular rami which measures about 150 mm. in length (Allen, 1921, p. 155, pl. 12, fig. 14), in all probability is not referable to "*Diaphorocetus*" *mediatlanticus* (Kellogg, 1925, p. 13, pls. 4–5), although it does belong to a sperm whale. The portion of the base of the skull, comprising the occipital condyles (Allen, 1921, p. 156, pl. 9, fig. 6) may represent the same extinct sperm whale.

No record seems to have been made of the stratigraphic position of the above-mentioned specimens in the phosphate deposits of Polk County, and consequently the two isolated teeth as well as the symphyseal fragment and the portion of the base of the skull may have been removed either from the lower Pliocene pebble phosphate deposits or from the underlying middle Miocene laminated blue clays. The transverse diameter of the ankylosed mandibular rami just in advance of the hinder end of the symphysis is about 57 mm. and the anteroposterior diameters of the alveoli vary from 18 to 22.5 mm. It is obvious that the roots of the two isolated teeth are too large to be lodged in a mandible of approximately the same dimensions as this symphyseal fragment. Even though one concedes that the discrepancy in size between the two isolated teeth (no. 17886, M.C.Z.) and the two teeth retained in the alveoli of the symphyseal fragment (no. 15751, M.C.Z.) may not exceed the limits of sex and age variation, no accurate comparisons can be made since the crowns and the necks of the roots of the two symphyseal teeth are destroyed.

CETOTHERIIDAE

? Mesocetus, species indet.

Plate 4

Referred specimens. The right and left bullae, no. 17885, Vertebrate Paleontology Catalogue, Museum of Comparative Zoölogy. Collector, George C. Elmore, 1941.

Horizon and locality. Laminated blue clays immediately below the

pebble phosphate, which are tentatively referred to the Hawthorn formation, in pits of the American Agricultural Chemical Company at Pierce, Polk County, Florida.

Description. The right and left bullae (no. 17885, M.C.Z.) are fairly complete, but are not associated with other cranial elements. On both of these bullae the very thin anterior pedicle and the accessory ossicle borne by it, as well as most of the posterior pedicle are missing.

These tympanic bullae have a broad furrow, which commences on the posterior face at the base of the posterior pedicle (pl. 4, fig. 3) and curves downward and then forward on the ventral face. This ventral furrow, or longitudinal depression, creates the broad indentation on the posterior border, as seen from below, and is narrowed anteriorly by the development of a prominent oblique keel or crest (pl. 4, figs. 2, 5), which originates at the anterior end and extends backward to about the level of the sigmoid process. The longitudinal furrow which divides the ventral face of the bulla into two lobes, an external (lateral) and an internal (mesial) one, has been considered by some to constitute a diagnostic feature of Recent Odontoceti. It is nevertheless true that this modification is more accentuated in the Odontoceti. The external (lateral) face, as seen from below, curves convexly from end to end, whereas the nearly straight internal (mesial) face is slightly indented near the middle of its length; the postero-external and postero-internal angles (pl. 4, fig. 2) are rounded.

The greatly thickened and inwardly reflected inner (mesial) lip, or involucrum (pl. 4, fig. 4), rather abruptly decreases in width anterior to the level of the sigmoid process. The dorsal surface of the involucrum exhibits an undulating curvature, interrupted posteriorly by rugosities and anteriorly by transverse creases. At the interior (eustachian) end of the bulla, the dorsal face of the involcrum merges imperceptibly with the curved outer lip, but is not depressed to form a cleft for the passage of the eustachian tube. The anterior end of the bulla of all known odontocetes is deeply scooped out, forming a spout-like cleft for the passage of the eustachian tube. Lillie (1910, pp. 779–780) and Hanke (1914, pp. 507, 509) found no trace of this cleft in the bullae of mysticetes. By dissection they have shown that the eustachian tube opens into the floor of the air sinus enclosed in the pterygoid fossa, which in turn communicates with the anterior end of the tympanic cavity of the bulla. This arrangement characterizes all the mysticetes, fossil or Recent, that have been studied.

There is a deep groove on the outer (lateral) lip of the bulla between the sigmoid process and the posterior conical apophysis. The posterior

process (pl. 4, fig. 4) is a thin plate of bone of irregular curvature at the base, bi-concave in front and concave behind, which projects from the involucrum. The sigmoid process is located on the outer (lateral) lip near the middle of the length of the bulla and the rounded distal end of this process is twisted at right angles to the long axis of the bulla. The elongated scar on the basal internal (mesial) border of the sigmoid process and the presence of a small fractured area on the outer (lateral) lip between the sigmoid process and the anterior process indicates that the slender anterior process of the malleus was as rigidly fixed as in Recent mysticetes.

Measurements of the Bullae (in millimeters)

	No. 17884, M.C.Z.		No. 17885, M.C.Z.	
	Right	Left	Right	Left
Greatest antero-posterior diameter	74	73.4	57.5	59.5
Greatest transverse diameter of bulla (but not including the sigmoid process)	41	41.5	37	39
Greatest transverse diameter of bulla, inner face (opposite basioccipital) to external swelling above sigmoid process	48	47	40.5	41.3
Greatest dorso-ventral diameter on external face, ventral face to tip of sigmoid process (with one arm of calipers resting on hinder end of involucrum and end of sigmoid process and the other arm on the ventral face of the bulla)	....	....	35.5	34.5
Transverse diameter of sigmoid process	....	....	12.5	12.8
Greatest length of involucrum	73.7	73.5	57.5	59
Greatest distance between outer lip of bulla and opposite (inside) face of involucrum	....	22	15.4	16

Remarks. The general conformation of these bullae suggested comparison with *Mesocetus hungaricus* (Kadic, 1907, p. 33, fig. 3), although the antero-posterior diameter of the bulla of the latter is 70 mm. Unfortunately, only the left bulla of *M. hungaricus* was found and most of the outer (lateral) lip is destroyed. This left bulla has a longitudinal furrow on the ventral face and an involucrum of approximately the same shape and appearance; the postero-internal (mesial) angle seems to protrude less conspicuously. The contour of the bulla of the genotype *Mesocetus longirostris* (Beneden, 1886, pl. 35, figs. 2–12), as seen from below, does not match that of these Florida bullae very closely; the former does have a similar longitudinal furrow on the ventral face, but on the other hand the postero-internal (mesial) angle does not protrude to the same extent and the posterior border is rounded and not indented medially. There is a strong possibility that these Florida bullae may belong to one of the previously described Miocene cetotheres, but no definite allocation will be made until more adequate material is available for study.

? Isocetus, species indet.

Plate 5

Referred specimens. The right and left bullae, no. 17884, Vertebrate Paleontology Catalogue, Museum of Comparative Zoölogy. Collector, George C. Elmore, 1941.

Horizon and locality. Presumably from the laminated blue clays immediately below the pebble phosphate, which are tentatively referred to the Hawthorn formation, in pits of the American Agricultural Chemical Company at Pierce, Polk County, Florida. Middle Miocene.

Description. The right and left bullae (no. 17884, M.C.Z.) are incomplete and fractured in several places. On both of these bullae, the sigmoid process and adjoining portion of the overarching outer (lateral) lip, as well as the thin anterior process and the posterior process are destroyed. The posterior conical apophysis also is destroyed on the right bulla.

The posterior face of the left bulla (pl. 5, fig. 6) is characterized by the deep and more or less vertical groove which terminates in the notch between the posterior conical apophysis and the base of the thin posterior process. This groove, if present, was reduced in length on the

right bulla. The posterior face is strongly convex, the apex of this curvature merging imperceptibly into the low longitudinal crest on the ventral surface. This longitudinal crest divides the ventral surface of the bulla into two sloping surfaces, an external (lateral) and an internal (mesial) one. When viewed from below (pl. 5, fig. 5), the external (lateral) face, lateral to the longitudinal ventral crest, exhibits an almost three-sided contour, whereas the internal (mesial) face is somewhat depressed near the middle of its length. From a ventral view, there are no postero-external and postero-internal angles; the posterior end is strongly convex and the anterior end is obliquely truncated.

The greatly thickened and inwardly reflected internal (mesial) lip, or involucrum (pl. 5, fig. 1), rather abruptly decreases in width at about the level of the hinder edge of the anterior process. The dorsal surface of the involucrum exhibits a sub-concave curvature from end to end, interrupted by transverse creases. At the anterior (eustachian) end of the bulla, the dorsal face of the involucrum merges imperceptibly with the curvature of the thickened outer (lateral) lip, and although slightly depressed it does not form a cleft for the passage of the eustachian tube.

Judging from the curvature of the outer (lateral) lip of the left bulla (pl. 5, fig. 4), there seems to have been a deep groove between the greatly elongated posterior conical apophysis and the sigmoid process which is destroyed. The laterally flattened and triangular posterior conical apophysis projects at least 8 mm. beyond the level of the base of the posterior process. The posterior process (pl. 5, fig. 1) is a thin plate of bone, almost straight at the base, which projects from the involucrum. The anterior process seems not to have been very broad antero-posteriorly.

Measurements: (see table p. 456).

Remarks. Compared with the bullae of other described North American cetotheres, the elongation of the triangular posterior conical apophysis is most unusual. It is assumed that the right and left bullae belonged to an immature individual since the ventral surface is but slightly roughened and the median longitudinal crest is not fully developed. This assumption is corroborated to some extent by comparison with a right and a left bulla (no. 5499, U.S.N.M.), unquestionably belonging to different individuals, which were found in the phosphate deposits at Tigerbay, Polk County, Florida. Most of the outer (lateral) lip and a portion of the anterior end of the right bulla are broken off, but in the present condition it measures 81.8 mm. in length; the distance from the ventral face of the bulla to the dorsal face of the involu-

crum is 42.5 mm. [The corresponding measurement of the right bulla from Pierce is 38.3 mm.] This right bulla has a strongly roughened ventral surface, a high median longitudinal crest on the ventral face which continues upward on the center of the posterior face almost to the interval between the posterior conical apophysis and the base of the posterior process, and deep transverse creases on the dorsal face of the involucrum. On the internal (mesial) side, the surface of the involucrum tends to fold over the ventral surface of the bulla. There is a rather close agreement between the general conformation of this right bulla and that of *Isocetus depauwii* (Beneden, 1886, pl. 71, figs. 3–8) from the upper Miocene Anversian stage of the Antwerp basin, Belgium. Notwithstanding the close similarity in most details to the Tigerbay bulla, it is well to call attention to the presence on the posterior face of the left bulla of *Isocetus depauwii* (Beneden, 1886, pl. 71, fig. 8) of two well developed ridges which converge near the base of the posterior process. These ridges are not so well developed on the right bulla from Tigerbay. The left bulla from Tigerbay is incomplete, but is relatively smooth and approximately the same size and shape as the bullae from Pierce. The differences observed are sufficient to establish specific distinctness, but in the absence of corroboratory cranial material, all four of these bullae are tentatively referred to *Isocetus*.

BALAENOPTERIDAE

Balaenoptera floridana, new species

Plate 6

Type. An essentially complete right mandible, somewhat crushed in median region, no. 17882, Vertebrate Paleontology Catalogue, Museum of Comparative Zoölogy. Collector, George C. Elmore, 1941.

Horizon and locality. Pebble phosphate, referred to the Bone Valley formation, in pits of the American Agricultural Chemical Company at Pierce, Polk County, Florida. Lower Pliocene.

Description. Horizontal ramus of right mandible bowed outward; internal surface of horizontal ramus distinctly flattened, external surface strongly convex; relatively short symphyseal region similar in most respects to corresponding portions of mandibles of finbacks and sei whales, and not roughened or pitted for insertion of connecting

ligaments; a well defined internal ledge above inferior groove extending backward for some 400 mm. on distal end of mandible; mandible constricted dorso-ventrally behind distal expansion and also in front of coronoid process, the maximum dorso-ventral diameter of ramus being near middle of its length (ramus of both finback and sei whale tapers

Fig. 5. *Balaenoptera floridana*, cross section right mandible, 100 mm. behind anterior end, no. 17882, M.C.Z.

gradually in depth from in front of coronoid process to tip); cross section of mandible 100 mm. behind anterior end (fig. 5) distinctly flattened from side to side, whereas dorsal half is twice width of ventral half in same section of an immature finback mandible (no. 16039, U.S.N.M.); cross section 300 mm. behind anterior end (fig. 6) is ovate-pyriform in outline in contrast to ovate outline of cross section taken at same distance from tip of immature finback mandible; cross section 1600 mm. behind anterior end (fig. 8) rounded ovate in contrast to marked internal flattening of section taken in corresponding portion of immature finback mandible; internal series of small foramina, located in narrow longitudinal groove on alveolar edge of mandible, for most part obliterated by erosion (internal row of foramina quite

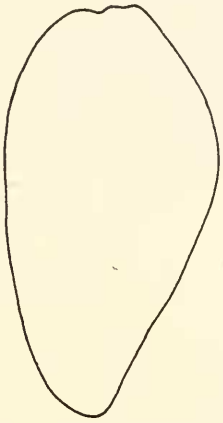


Fig. 6. *Balaenoptera floridana*, cross section of right mandible, 300 mm. behind anterior end, no. 17882, M.C.Z.

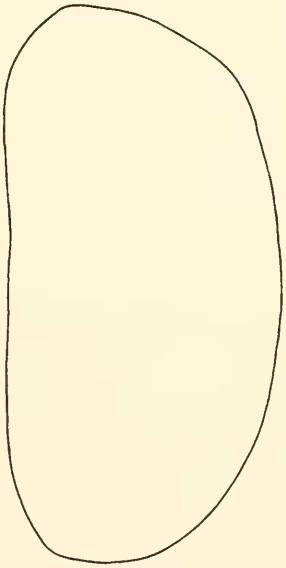


Fig. 7. *Balaenoptera floridana*, cross section of right mandible, 1000 mm. behind anterior end;probably some distortion from crushing, no. 17882, M.C.Z.

conspicuous on immature and adult finback mandibles); mental foramina on external surface concealed by reconstruction of crushed areas (external mental foramina relatively large and located at varying intervals on anterior three fourths of finback and sei whale mandibles); small triangular coronoid process bent outward toward apex (coronoid process of finback mandible distinctly elongated); a small subsidiary

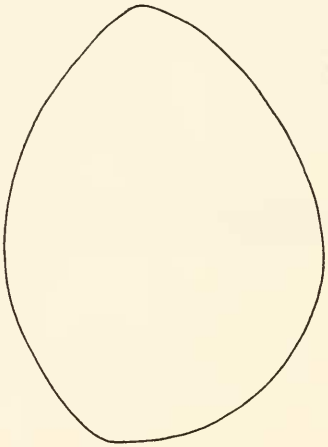


Fig. 8. *Balaenoptera floridana*, cross section of right mandible, 1600 mm. behind anterior end, no. 17882, M.C.Z.

process behind and below base of coronoid process, likewise bent outward, representing anterior termination of elongated protuberance on dorso-internal side of ramus, a distinctive characteristic of balaenopterine whales; maximum dorso-ventral diameter of elongated dorso-internal protuberance 42 mm. and distance from anterior rim of large internal dental foramen to apex of subsidiary process 115 mm.; area in front and above large internal dental foramen more like condition exhibited by mandibles of immature finbacks than of sei whales (no subsidiary process at anterior termination of dorso-ventrally elongated protuberance on either finback or sei whale mandibles); horizontal distance from hinder face of condyle to apex of coronoid process slightly more than 18 percent of greatest length of mandibles of *B.*

floridana and immature finback, but distance from anterior rim of large internal dental foramen to apex of coronoid process relatively greater in *B. floridana;* condyle (fig. 10) abruptly narrowed below level of deep furrow on external side (posterior aspect of condyle of *B. flori-*

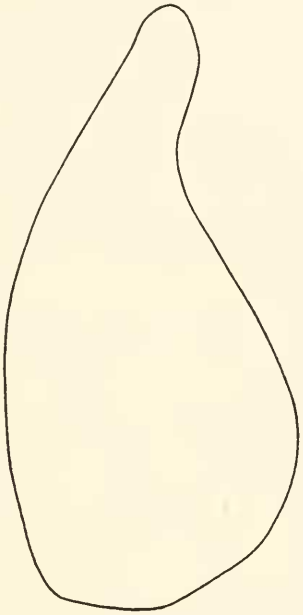


Fig. 9. *Balaenoptera floridana*, cross section through coronoid process, 1860 mm. behind anterior end, no. 17882, M.C.Z.

dana more like that of a young 26 foot sei whale (no. 239307, U.S.N.M.), except that the latter possesses a well defined groove on internal face and only a slight notch on external face); dorsal half of condyle truncated obliquely in dorso-ventral direction and convexedly curved from external to internal margin; ventral half depressed medially in oblique direction and truncated more or less at right angles to long axis of ramus; condyle also strongly compressed from side to side in contrast to pronounced side to side widening of dorsal half of condyle on man-

dibles of finback and sei whales [ratio of width of upper half of condyle to lower half 185 to 110 in case of immature finback and 230 to 200 in case of adult sei whale; groove present on internal and external faces of condyles of finback and sei whale mandibles; external and in-

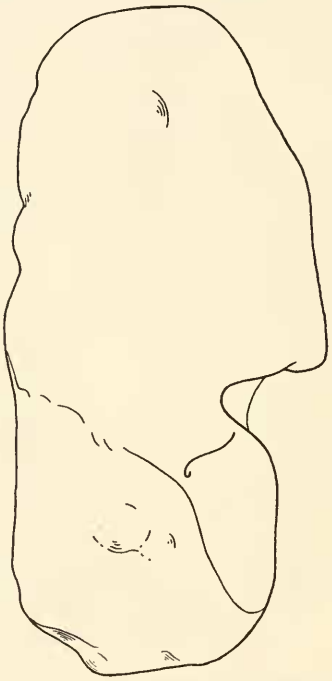


Fig. 10. *Balaenoptera floridana*, posterior view of condyle, no. 17882, M.C.Z.

ternal grooves on condyle of immature finback (no. 16039, U.S.N.M.) connected by deep transverse furrow, dividing condyle into a large elongated dorsal articular surface and a relatively small ventral surface; transverse groove on condyle of adult finback (no. 237566, U.S.N.M.) somewhat shallower than on immature mandibles].

Measurements (in millimeters):

Greatest length of mandible in a straight line	2123
Greatest length of mandible along outside curvature	2256
Distance from anterior end to level of center of coronoid process in a straight line	1750
Greatest vertical diameter 100 mm. behind anterior end of ramus	127
Greatest transverse diameter 100 mm. behind anterior end of ramus	47.8
Greatest vertical diameter 300 mm. behind anterior end of ramus	108.5
Greatest transverse diameter 300 mm. behind anterior end of ramus	57.8
Greatest vertical diameter 1000 mm. behind anterior end of ramus	150 ±
Greatest transverse diameter 1000 mm. behind anterior end of ramus	74 ±
Greatest vertical diameter 1600 mm. behind anterior end of ramus	117.5
Greatest transverse diameter 1600 mm. behind anterior end of ramus	84
Greatest vertical diameter of ramus through coronoid process	163
Greatest transverse diameter of ramus at level of coronoid process	77
Least vertical diameter of ramus between coronoid process and condyle	117
Horizontal distance between center of coronoid process and hinder face of condyle	392
Distance from hinder face of condyle to anteriormost free rim of entrance to dental canal	227
Greatest dorso-ventral diameter of condyle	179
Greatest transverse diameter of condyle	87

Remarks. The right mandible (pl. 6) of this fossil balaenopterine whale is somewhat shorter and slenderer than the mandibles of either of the two immature finbacks in the U. S. National Museum, and differs also in other details of conformation. If this mandible belonged to an adult, this extinct whale was somewhat smaller than the Recent finback, *Balaenoptera physalus*, and considerably larger than the little piked whale, *Balaenoptera acutorostrata*. No marked alterations in the general conformation of the mandibles of immature and adult balaenopterine whales have been observed and it is therefore difficult to estimate the age of extinct mysticetes represented solely by mandibles.

The length of this fossil mandible in a straight line is 2m 123 mm. The right mandible of a Recent immature finback (no. 16039, U.S.N.M.) the length of whose skeleton is unknown, measures 2m 610 mm. in a straight line. The length in a straight line of a right mandible belonging to a 47 ft. 7 in. finback skeleton (no. 16045,

U.S.N.M.) is approximately 3 m. It should be noted also that the right mandible of an old male sei whale, *Balaenoptera borealis* (no. 239307, U.S.N.M.), about 45 feet in length, measures in a straight line 3m 290 mm.

The right mandible of *Balaenoptera floridana* differs in essential structural details from the mandibles of most of the fossil mysticetes (Strobel, 1881) described from Pliocene horizons in Italy, although it does resemble in certain features the left mandible described and figured by Portis (1885, pp. 44–46, pl. 4, figs. 42–47) under the name *Balaenoptera cortesii*. This last mentioned mandible, measuring 2m 38 mm. in length, was collected by Gastaldi in 1874 in a middle Pliocene (Astian) sand bank at Montafia, Piemonte, Italy. The type skeleton of *Balaenoptera cortessii* (Fischer), measuring 4m 50 mm. in length, was found, however, by Cortesi in 1816 in the lower Pliocene (Plaisancian) sandy blue clay of a stream which descends from Montezago and empties into the Chiavenna River, a tributary of the Po River, Piemonte, Italy.The mandible belonging to the type skeleton measures 1m 150 mm. in length and possesses characters that distinguish it from the Montafia mandible.

The mandible from Montafia has a low triangular coronoid process, the condyle compressed from side to side and obliquely truncated when viewed from the side, the distal end of ramus dorso-ventrally expanded, the ramus constricted dorso-ventrally behind distal expansion and also in front of coronoid process, and the ledge above inferior groove on internal surface of anterior end of ramus essentially similar in position. Notwithstanding these points of resemblance, the Montafia mandible seems to lack the subsidiary process behind and below base of the coronoid process, the inner surface of anterior end of ramus is roughened for insertion of connecting ligaments, the distal end is noticeably widened from side to side, the posterior aspect of the condyle is quite different in conformation, and the groove on the external face of the condyle is connected by a transverse furrow with the corresponding groove on the internal face of the condyle.

Among the skeletal remains of mysticetes found in the lower Pliocene (Diestian) sands of the Antwerp Basin, Belgium, Beneden (1885, pt. 4) has recognized several species, three of which, *Plesiocetus brialmontii*, *P. dubius*, and *P. hupschii*, are represented by portions of mandibles. Only one of these, *P. dubius*, exhibits a close resemblance to the Florida mysticete. Notwithstanding the close similarity between the size and conformation of the anterior end of the mandible of *P. dubius* and the corresponding portion of the mandible of *B. floridana*, the greater

width of the ramus and the position of the external mental foramina readily distinguish the former from the latter.

From the middle Pliocene (Scaldisian) sands of the Antwerp Basin, Belgium, Beneden (1882, pt. 3) has figured the whole or portions of mandibles identified as *Balaenoptera borealina*, *B. musculoides*, *B. rostratella*, *Burtinopsis minutus*, and *B. similis*. It should be noted that Beneden (1882, pt. 3, p. 651) has stated that the cetacean, which he (1859, p. 141) had dedicated to Van Gorp under the name of *Plesiocetus garopii*, was the same as *Balaenoptera musculoides* (Beneden, 1880, p. 15). The mandibles of the fossil mysticetes allocated to the genus *Balaenoptera* by Beneden are distinguishable from *Balaenoptera floridana* by the conformation of the condyle, the dental foramen, and the ramus, especially the anterior end. The mandible of *B. floridana* is likewise readily separable from those of *Burtinopsis minutus* and *B. similis* by the shape of the condyle.

Four names have been bestowed by Owen (1846, pp. 531–534) on incomplete mysticete bullae found in the upper Pliocene Red Crag nodule bed at Felixstow, Suffolk, England. Until comparable material representing the Florida mysticete is collected, the relationships of these British species to *B. floridana* can not be ascertained.

LITERATURE CITED

Abel, O.

1899. Untersuchungen über die fossilen Platanistiden des Wiener Beckens. Denkschr. math.-naturwiss. Kl. Kais. Akad. Wissensch. Wien, **68**, pp. 839–874, pls. 4.

1905. Les odontocètes du Bolderien (Miocène supérieure) d'Anvers. Mém. Mus Roy. d'Hist. Nat. Belgique, Bruxelles, **3**, pp. 1–155, figs. 27.

1909. Der Schädel von Saurodelphis argentinus aus dem Pliozän Argentiniens. Sitz.-ber. kais. Akad. Wissensch. Wien, math.-naturw. Kl. **118**, Abt. 1, pp. 255–272, pl. 1, fig. 1. March, 1909.

Allen, Glover M.

1921. Fossil cetaceans from the Florida phosphate beds. Jour. Mammalogy, **2**, no. 3, pp. 144–159, pls. 9–12. August, 1921.

1941. A fossil river dolphin from Florida. Bull. Mus. Comp. Zoöl. Harvard College, **89**, no. 1, pp. 1–8, pls. 3. October, 1941.

Ameghiño, Florentino.

1891a. Caracteres diagnósticos de cincuenta especies nuevas de mamíferos fósiles argentinos. Rev. Argentina Hist. Nat., Buenos Aires, **1**, entr. 3a, pp. 129–167, figs. 26–75. June 1, 1891.

1891b. Mamíferos y aves fósiles argentinos.—Especies nuevas, adiciones y correcciones. Rev. Argentina Hist. Nat., Buenos Aires, **1**, entr. 4a, pp. 240–259, fig. 1. August 1, 1891.

1898. Sinopsis Geológico-Paleontológica (Formaciones cenozóicas y cretáceas). Segundo Censo de la Republica Argentina Mayo 10 de 1895, Buenos Aires, **1** (Territorio), pp. 113–255+ [1], figs. 104.

Beneden, P. J. van.

1859. Ossements fossiles découverts à Saint-Nicholas, en 1859. Bull. Acad. Roy Sci. Belgique, Bruxelles, ser. 2, **8**, no. 11, pp. 123–148.

1880. Les Mysticètes à courts fanons des sables des environs d'Anvers. Bull. Acad. Roy. Sci. Belgique, Bruxelles, ser. 2, **50**, pp. 11–25.

1882. Description des ossements fossiles des environs d'Anvers. Pt. 3, Cétacés. Genres: Megaptera, Balaenoptera, Burtinopsis et Erpetocetus. Ann. Mus. Roy. Hist. Nat. Belgique, Bruxelles, sér. Paléont., **7**, pp. 1–90, pls. 40–109.

1885. Description des ossements fossiles des environs d'Anvers. Pt. 4, Cétacés. Genre: Plesiocetus. Ann. Mus. Roy. Hist. Nat. Belgique, Bruxelles, sér. Paléont., **9**, pp. 1–40, pls. 1–30.

1886. Description des ossements fossiles des environs d'Anvers. Pt. 5, Cétacés. Genres: Amphicetus, Heterocetus, Mesocetus, Idiocetus et Isocetus. Ann. Mus. Roy. Hist. Nat. Belgique, Bruxelles, sér. Paléont., **13**, pp. 1–139, pls. 75.

BENEDEN, P. J. VAN, AND P. GERVAIS.
1880, Ostéographie des Cétacés vivants et fossiles. Paris, Text, pp. 1–605; Atlas, folio pls. 1–64.

BRANDT, J. F.
1873. Untersuchungen über die Fossilen und Subfossilen Cetaceen Europa's. Mém. Acad. Imp. Sci. St.-Pétersbourg, sér. 7, **20**, no. 1 pp. viii + 372, pls. 34.

BURMEISTER, HERMANN.
1871. On Saurocetes argentinus, a new type of Zeuglodontidae. Ann. and Mag. Nat. Hist., ser. 4, **7**, no. 37, pp. 51–55, pl. 1. January, 1871.
1891a. La Prensa, Buenos Aires, June 26, 1891.
1891b. Nuevos objetos en el museo nacional. Anal. Soc. Cient. Argentina, Buenos Aires, **32**, entr. 4, pp. 161–163. October, 1891.
1892. Continuacion à las adiciones al examen crítico de los mamíferos fósiles terciarios. Anal. Mus. Nac. Buenos Aires, **3**, entr. 18, pp. viii + 401–488, pls. 7–10.

CABRERA, ANGEL.
1926. Cetáceos fósiles del Museo de la Plata. Rev. Mus. La Plata, **29**, pp. 363–411, figs. 19.

COOKE, C. W., AND S. MOSSOM.
1929. Geology of Florida. 20th Ann. Rept. Florida State Geol. Surv., pp. 29–227.

CUVIER, GEORGES.
1825. Recherches sur les ossements fossiles, Paris, 3rd ed., **5**, pp. 1–405, pls. 27.

FISCHER, JOANNE BAPTISTA.
1829. Synopsis Mammalium, Stuttgart, pp. xlii + 752.

GERVAIS, PAUL.
1859. Zoologie et Paléontologie françaises, Paris, ed. 2, pp. viii + 544; atlas, pp. xii, pls. 84.

HANKE, HERBERT.
1914. Ein Beitrag zur Kenntnis der Anatomie des äusseren und mittleren Ohres der Bartenwale. Jenaischen Zeitschr. f. Naturwiss., **51**, no. 3, pp. 487–524, pls. 3.

HOLL, FRIEDRICH.
1829. Handbuch der Petrefactenkunde, Dresden, Erstes Bändchen, pp. viii + 115. (Allgemeine Taschenbibliothek der Naturwissenschaften, Theil 9.)

Kadic, Ottokar.
1907. Mesocetus hungaricus Kadic, eine neue Balaenopteridenart aus dem Miozän von Borbolya in Ungarn. Mitteil. Jahrb. Kgl. Ungarischen Geol. Anstalt, Budapest, **16**, no. 2, pp. 23–91, figs. 70, pls. 3.

Kellogg, Remington.
1925. Additions to the Tertiary history of the pelagic mammals on the Pacific Coast of North America. Carnegie Instn. Washington Publ. 348, pp. iii + 120, pls. 13. April 22, 1925.

Lillie, D. G.
1910. Observations on the anatomy and general biology of some members of the larger Cetacea. Proc. Zool. Soc. London for 1910, pt. 3, pp. 769–792, figs. 69–78, pl. 74. October 11, 1910.

Owen, Richard.
1846. A history of British fossil mammals and birds, London, pp. xlvi + 560, figs. 236.

Portis, Alessandro.
1885. Catalogo descrittivo dei Talassoterii rinvenuti nei Terreni Terziarii del Piemonte e della Liguria. Mem. R. Accad. Sci. Torino, ser. 2, **37**, pp. 247–365, pls. 9.

Rovereto, Cayetano.
1915 Nuevas investigaciones sobre los delfines longirostros del Mioceno del Paraná (República Argentina). Ann. Mus. Nac. Buenos Aires, **27**, pp. 139–151, pls. 2–4. September 9, 1915.

Simpson, G. G.
1930. Tertiary land mammals of Florida. Bull. Amer. Mus. Nat. Hist., **59**, pp. 149–211. June 5, 1930.
1932. Fossil Sirenia of Florida and the evolution of the Sirenia. Bull. Amer. Mus. Nat. Hist., **59**, pp. 419–503, figs. 23. September 6, 1932.

Strobel, P.
1881. Iconografia comparata delle ossa fossili del Gabinetto di Storia Naturale dell' Universita di Parma. Fasc. 1, Balenotteride (Cetoterio e Megattera), Parma, pp. 1–32, pls. 5.

True, Frederick W.
1909. A new genus of fossil cetaceans from Santa Cruz Territory, Patagonia; and description of a mandible and vertebrae of Prosqualodon. Smithson. Misc. Coll., **52**, pt. 4, pp. 441–456, pls. 43–45. August 7, 1907.

1910. Description of a skull and some vertebrae of the fossil cetacean Diochotichus vanbenedeni from Santa Cruz, Patagonia. Bull. Amer. Mus. Nat. Hist., **28**, art. 4, pp. 19–32, pls. 1–5. March 22, 1910.

1912. A fossil toothed cetacean from California, representing a new genus and species. Smithson. Misc. Coll., **60**, no. 11, pp. 1–7, pls. 2. November 1, 1912.

VALENCIENNES, A.

1862. Sur une mâchoire inférieure de Dauphin fossile envoyée par M. Thore, de Dax (département des Landes). Comptes Rendus Acad. Sci., Paris, **54**, no. 14, pp. 788–790.

WHITE, T. E.

1942. Additions to the fauna of the Florida phosphates. Proc. New England Zoöl. Club., **21**, pp. 87–91. November 14, 1942.

WILSON, LESLIE E.

1935. Miocene marine mammals from the Bakersfield Region, California. Peabody Mus. Nat. Hist., New Haven, Bull. 4, pp. 143, figs. 23.